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Orihara et al.

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(54) **IONIZER**

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(51) **Int. Cl.**
H01T 23/00 (2006.01)

(52) **U.S. Cl.** **361/230**; 361/231

(58) **Field of Classification Search** 361/212, 361/213, 230, 231
See application file for complete search history.

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(57) **ABSTRACT**

An ionizer is formed by coupling a fan unit provided with a discharge electrode and a fan and a control unit provided with an indicator and an adjuster to each other, and both units are changeable between a normal coupling condition, where both are directed in the same direction, and an opposite coupling condition, where they are directed in opposite directions to each other, and in addition, a power/signal arrangement of the connection terminals of the separate connector is bilaterally symmetrical such that same power and signals ale transmitted and received between the separate connectors of both units connected to each other in either coupling condition of aforementioned both units.

12 Claims, 5 Drawing Sheets

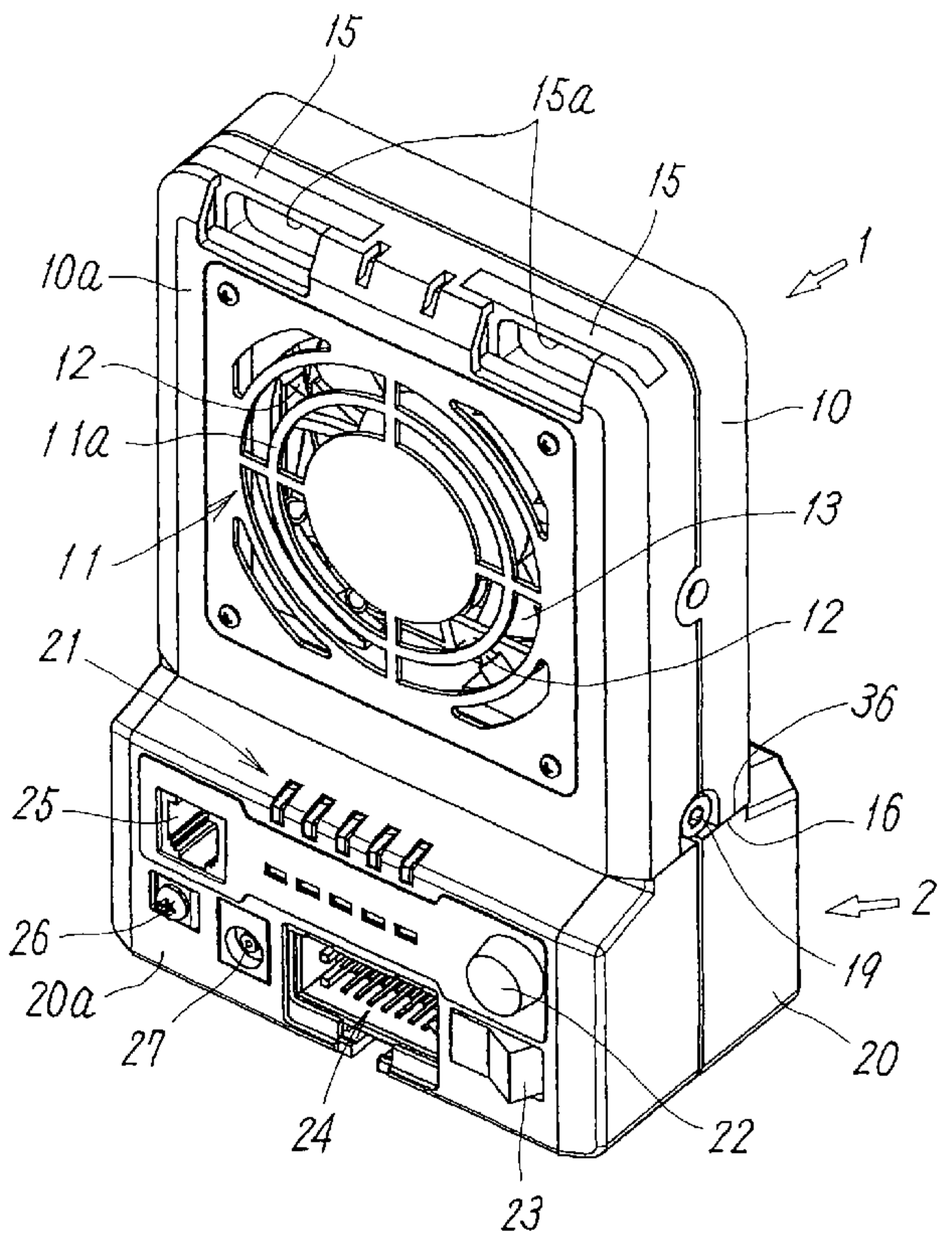
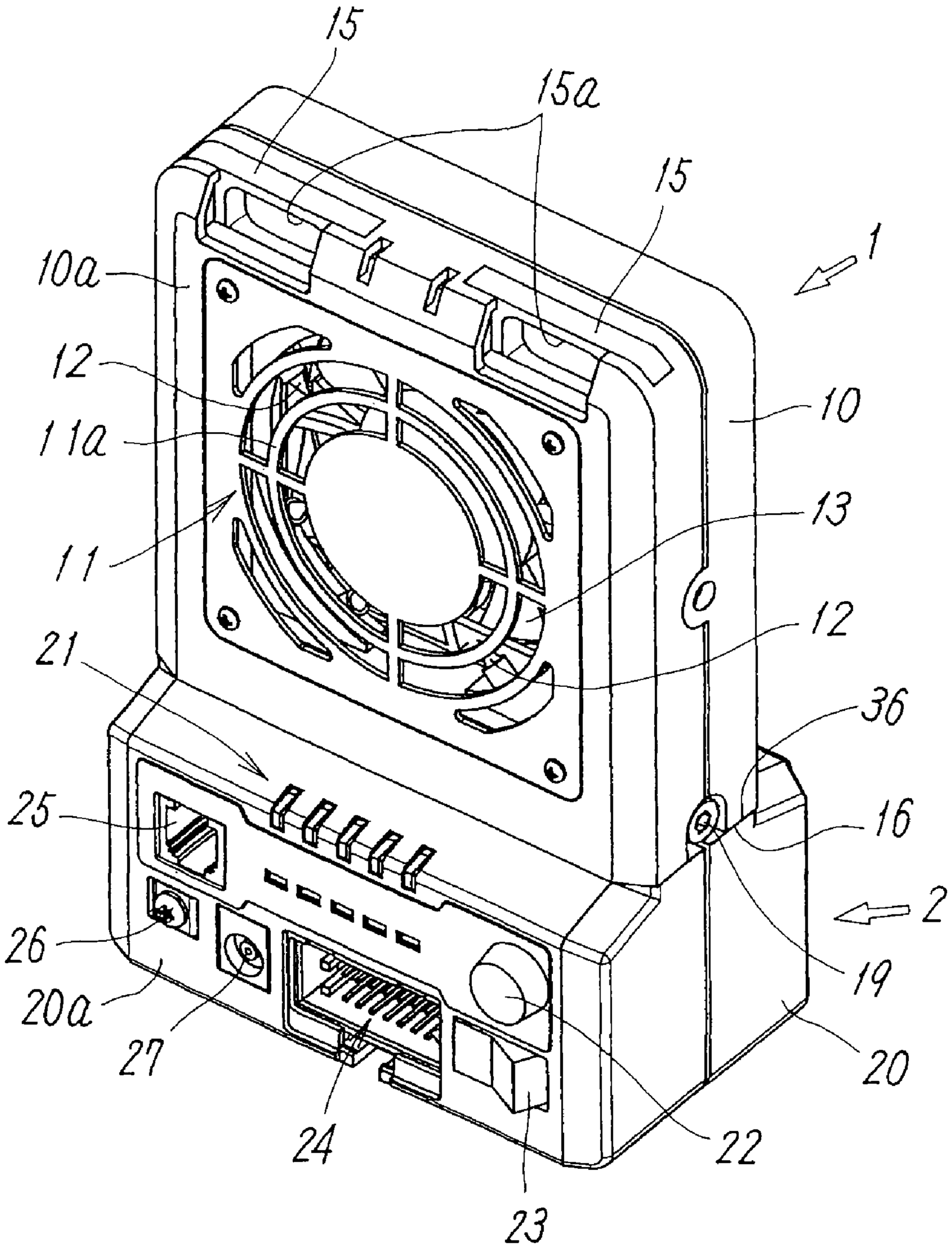


FIG. 1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15a
15
1
10a
12
10
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12
21
36
25
16
2
26
19
20a
27
20
24
22
23

FIG. 2

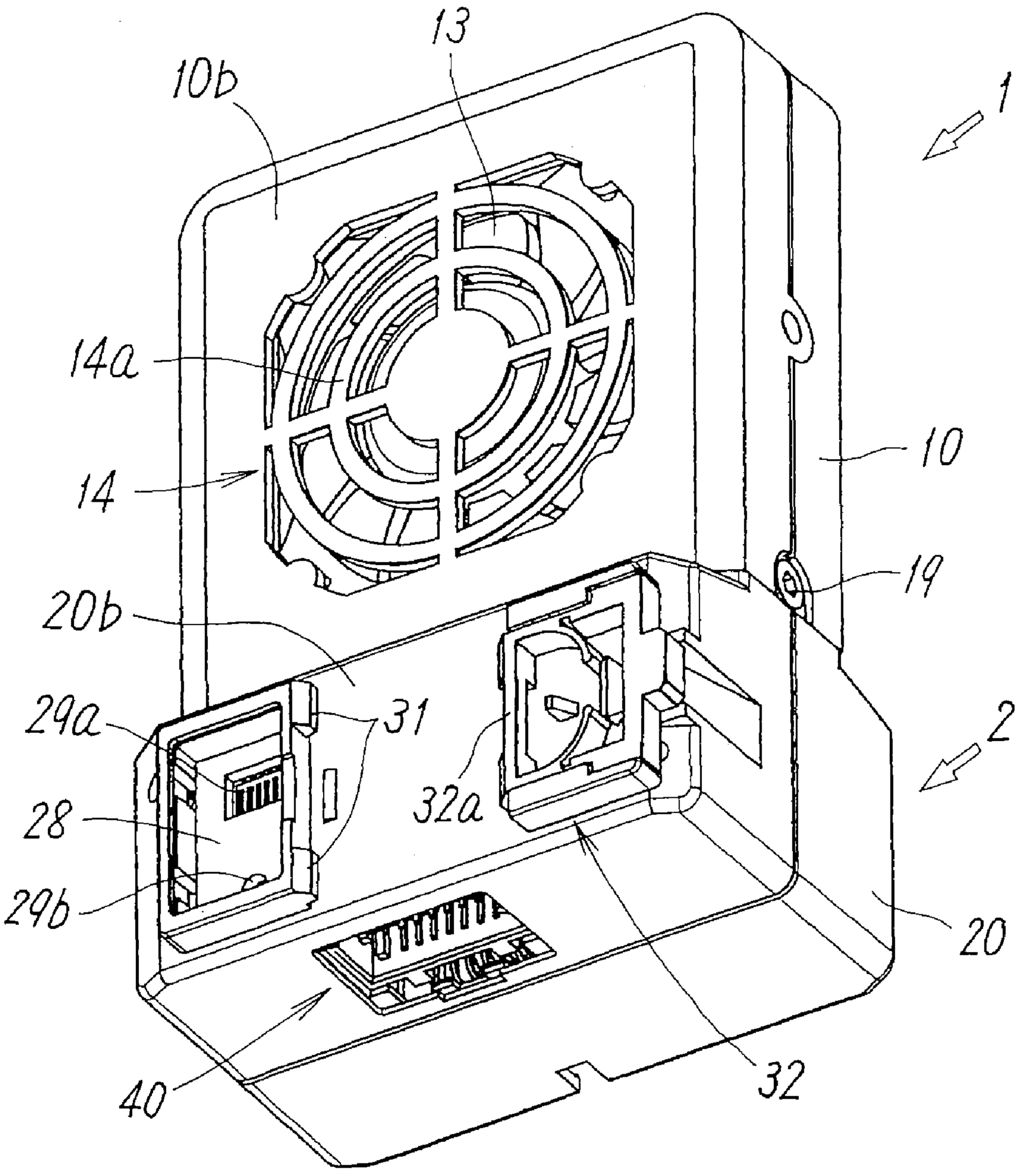


FIG. 3

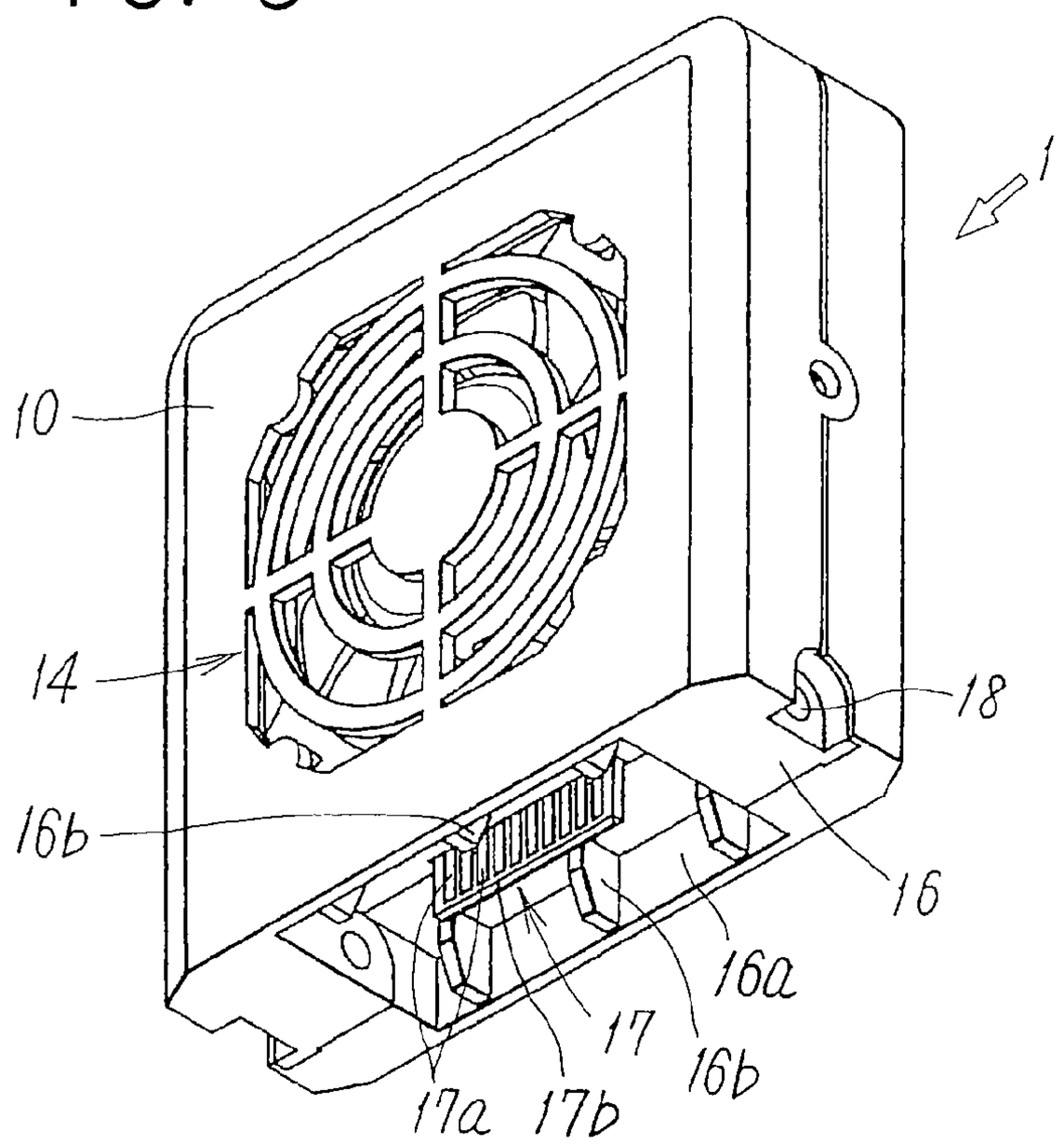

1
10
14
18
16b
16
16a
17
16b
17a
17b

FIG. 4

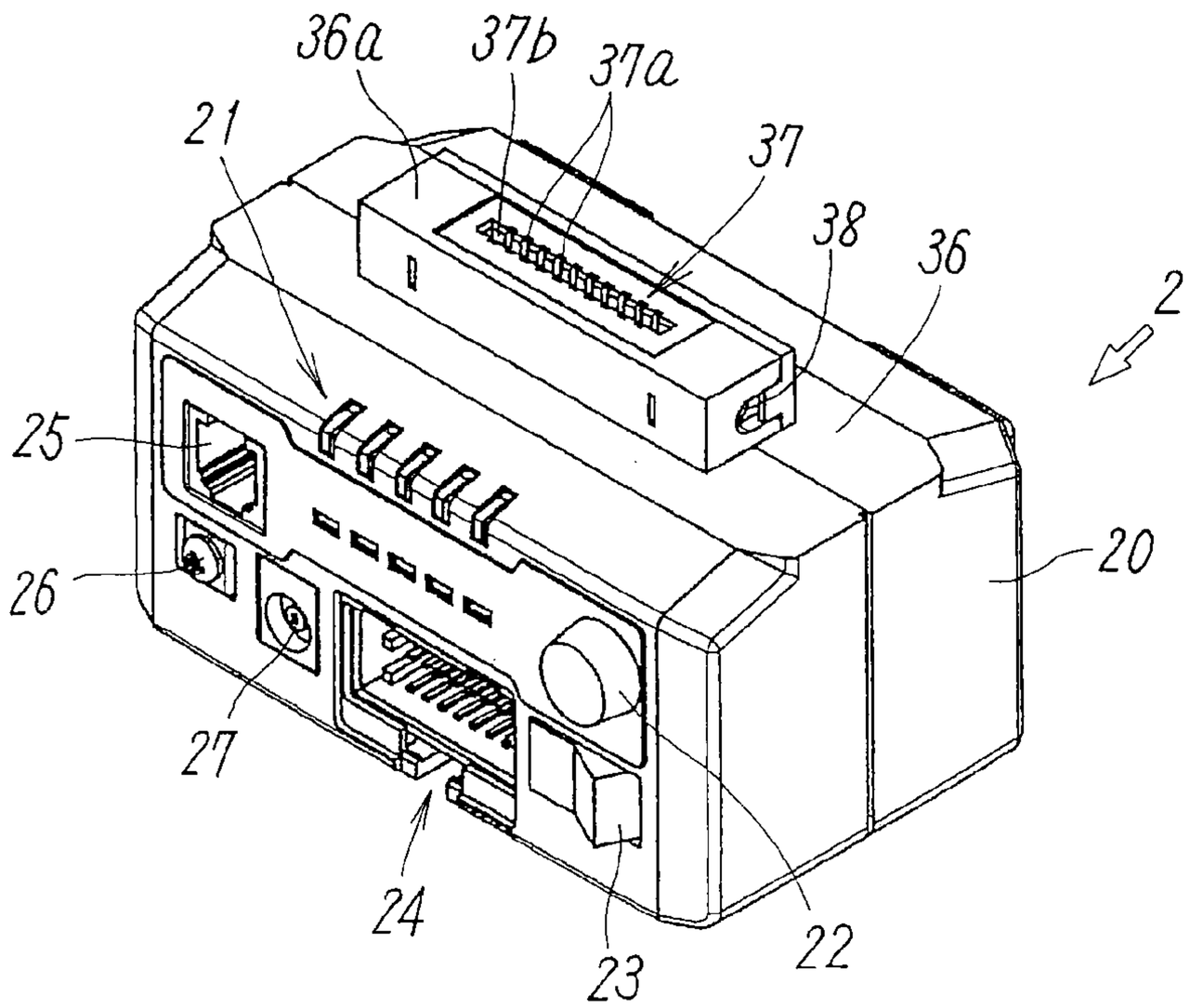

36a
37b
37a
21
37
38
36
2
25
26
20
27
24
23
22

FIG. 5

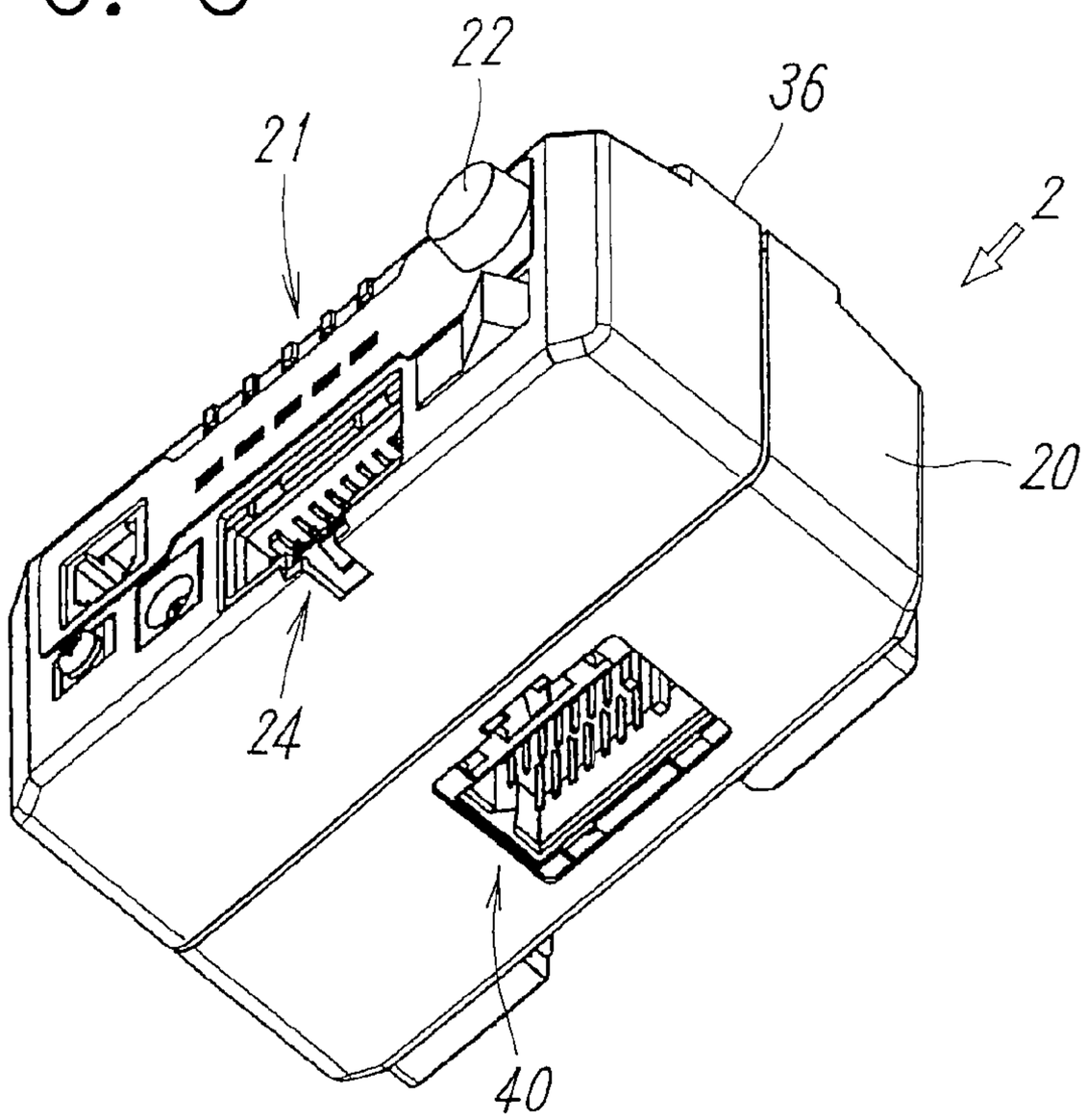


FIG. 6

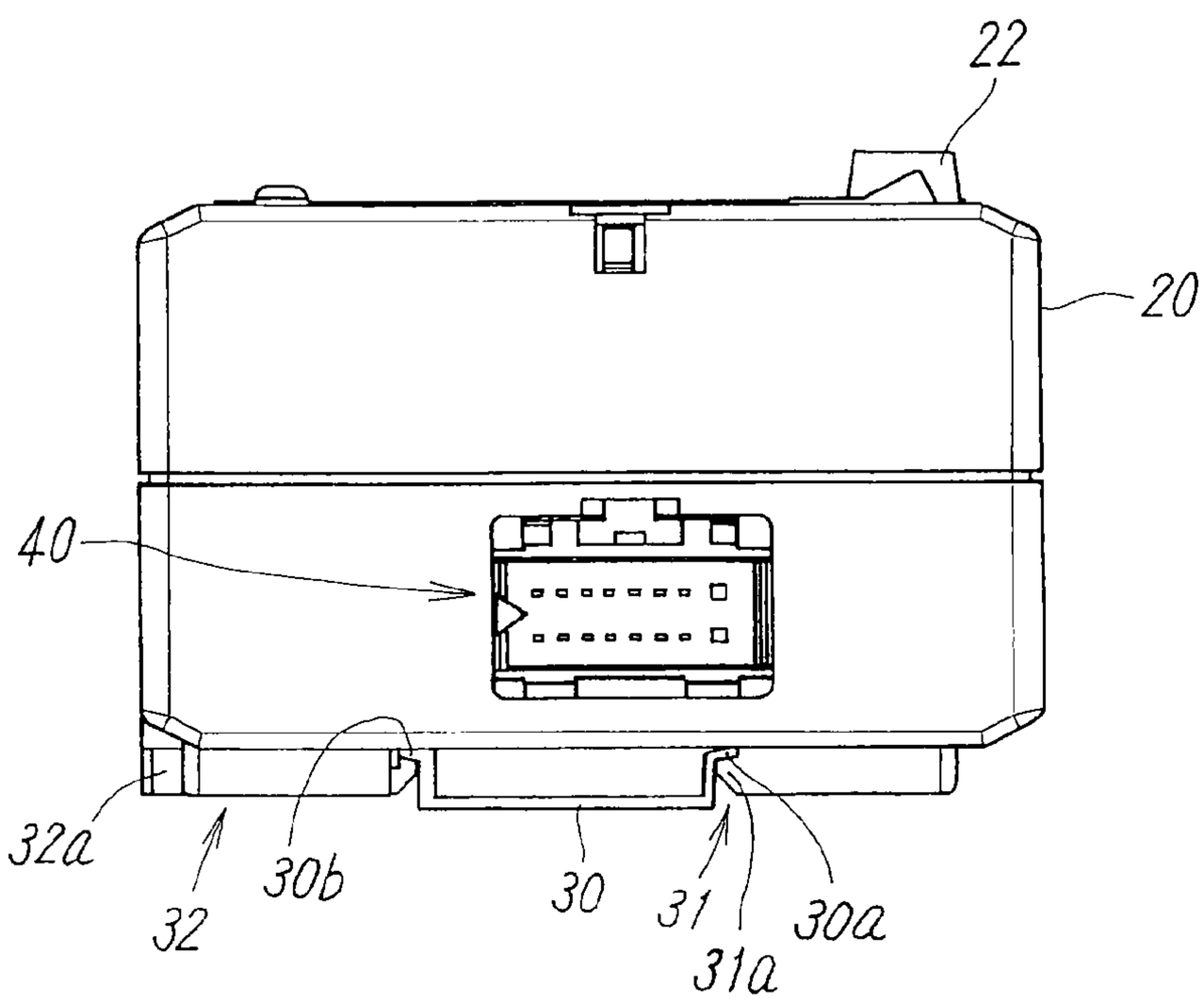


FIG. 7A

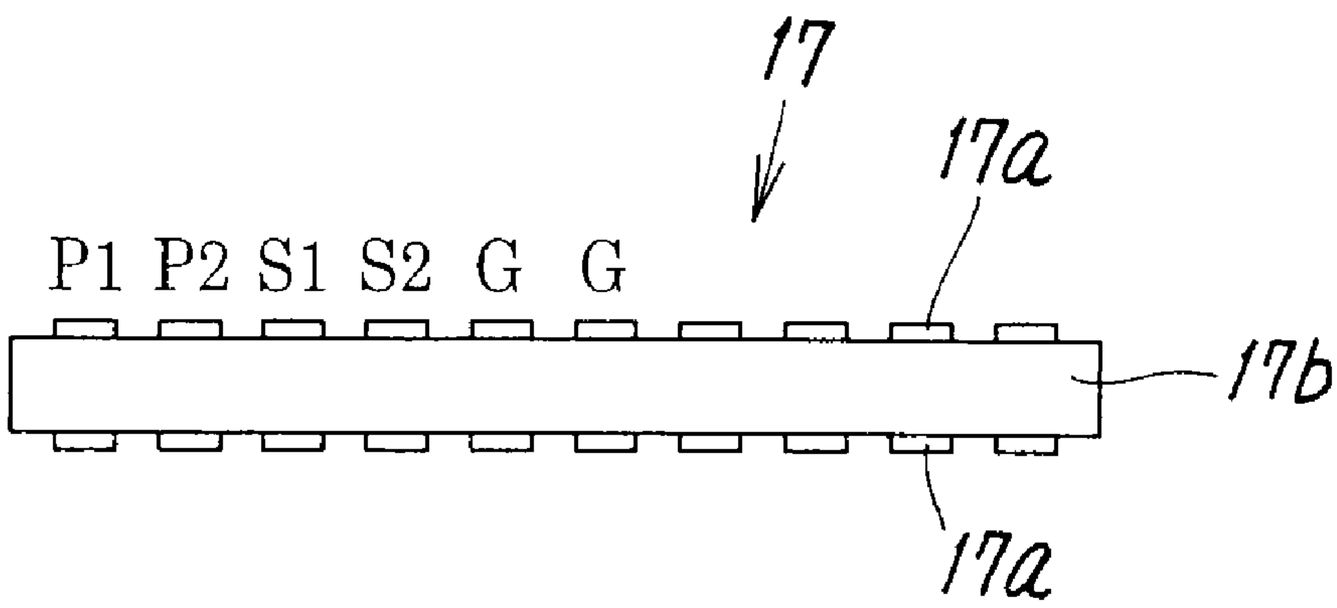
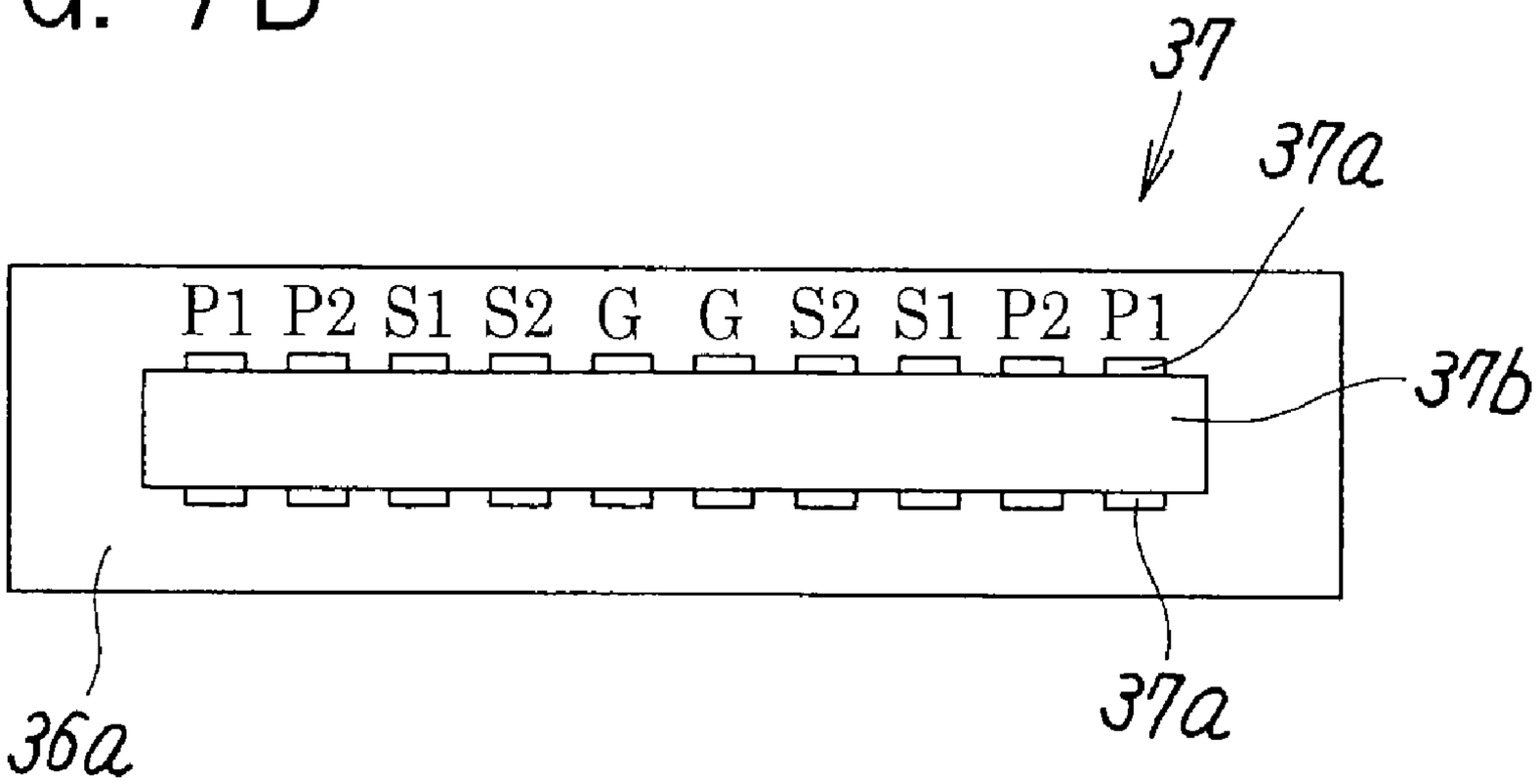

17
17a
P1 P2 S1 S2 G G
17b
17a

FIG. 7B


37
37a
P1 P2 S1 S2 G G S2 S1 P2 P1
37b
36a
37a

IONIZER

TECHNICAL FIELD

The present invention relates to a fan type ionizer constituted by a fan unit and a control unit.

BACKGROUND ART

In an existing fan type ionizer (refer to Japanese Unexamined Patent Application Publication No. 2004-253192, for example), in a substantially single housing, a discharge electrode generating ions by application of a high voltage, a fan generating air flow to discharge the generated ions from an air outlet of the housing, a high voltage generator for applying a high voltage to the discharge electrode, and a controller for controlling driving of the high voltage generator and the fan are mounted. Normally, an indicator indicating operating states of the ionizer, an adjuster for adjusting operating states of the ionizer, a control connector for connecting various wirings to an external power source for driving the high voltage generator and the fan and also to transmit and receive various electric signals to and from the outside, and the like are provided on a front of the housing provided with the air outlet for the air flow.

However, such fixed provision of an air outlet for air including ions, various indicators, various adjusters, a control connector for various wirings to a housing may sometimes makes it difficult for a worker handling the device to easily view the indicators, depending on the surrounding environment of the installation site of the ionizer, leading to inability to appropriately confirm readings of the indicators, inability to precisely operate the various adjusters, or difficulty in connecting wiring to the control connector.

DISCLOSURE OF INVENTION

A technical problem to be solved by the present invention is to enable changing of the relationship between the orientation of an air outlet for air including ions and the orientation of indicators, adjusters, and the like appropriately in accordance with the installation environment and the like of an ionizer and improving the usability of the ionizer.

Another technical problem to be solved by the present invention is to realize improved usability of the ionizer by simple means at a low cost.

In order to solve the problems, the present invention includes: a fan unit provided, in a first housing, with a discharge electrode generating ions by application of a high voltage and a fan generating air flow to transport the ions generated at the discharge electrode; and a control unit provided, in a second housing, with an indicator indicating an operating state of the ionizer and an adjuster for adjusting an operating state of the ionizer.

The fan unit and the control unit are formed separately from each other, the units being coupled detachably while coupling faces of the first housing and the second housing abut on each other and are also changeable between a normal coupling condition, where both units are oriented in the same direction from front to back, and an opposite coupling condition, where both units are oriented in opposite directions from front to back.

In addition, first and second separate connectors electrically connected to each other when the fan unit and the control unit are coupled are provided on the coupling faces, the separate connectors being connectable to each other in either case of the fan unit and the control unit being in the

normal coupling condition or the opposite coupling condition and also having connection terminals with a power/signal arrangement configured such that power supply and signal transmission/reception between both separate connectors is achieved in either coupling condition of both units.

In the present invention, it is preferable that the power/signal arrangement of the connection terminals of at least one of the separate connectors is bilaterally symmetrical.

In the ionizer of the present invention, a concave portion is formed on the coupling face of the first housing, the male type first separate connector is provided inside the concave portion, a convex portion is formed on the coupling face of the second housing, the female type second separate connector is provided inside the convex portion, and when abutting the coupling faces of the first housing and the second housing on each other, the convex portion fits in the concave portion and the first separate connector is inserted in the second separate connector to establish electrical connection.

In the present invention, it is desirable that the first separate connector and the second separate connector are provided at a center, lengthwise and widthwise, of respective coupling faces of the first housing and the second housing.

In addition, in the ionizer of the present invention, it is preferable that the control unit also serves as a base to mount the fan unit, and the coupling faces are formed on an bottom surface of the first housing and a upper surface of the second housing and coupled to the control unit with the fan unit being mounted on the control unit.

In the ionizer of the present invention, a control connector for connecting wiring from an external power source and wiring from another device transmitting and receiving various electric signals may also be provided on a front side of the second housing of the control unit.

In an ionizer having the above configuration, the fan unit and the control unit can be changed between a normal coupling condition and an opposite coupling condition while keeping the same arrangement of power/signal transmitted and received between both units in accordance with the environment of the installation site and the like. This enables changing the orientation of the ail outlet for air including ions relative to various indicators, various adjusters and the like in accordance with the working environment, and compared to conventional ionizers provided with the above in a fixed orientation, the usability of the ionizer is thus improved, such as better viewability of the indicators and easier operation of the various adjusters by a worker. Moreover, the improvement in usability can be realized by simple means at a low cost.

BRIEF DESCRIPTION OF DRAWINGS

FIG. **1** is a front side perspective view showing an Example of an ionizer according to the present invention.

FIG. **2** is a back side perspective view in the Example.

FIG. **3** is a perspective view illustrating an electric connector on a bottom surface of a fan unit in the Example.

FIG. **4** is a perspective view of a control unit in the Example.

FIG. **5** is a perspective view illustrating an electric connector on a bottom surface of the control unit in the Example.

FIG. **6** is a bottom view showing an installation embodiment of the control unit relative to a DIN rail.

FIG. **7**A is a plan view diagrammatically showing a power/signal arrangement of connection terminals of a first separate connector.

FIG. **7**B is a plan view diagrammatically showing a power/signal arrangement of connection terminals of a second separate connector.

BEST MODE FOR CARRYING OUT THE INVENTION

FIGS. **1** and **2** show an Example of an ionizer according to the present invention, and this ionizer is configured with a fan unit **1** and a control unit **2**.

Schematically, the fan unit **1** is provided, in a first housing **10** having a square box shape, with a plurality of discharge electrodes **12** generating ions by application of a high voltage generated in a high voltage generator and a fan **13** generating air flow to expel the generated ions from an air outlet **11** of the first housing **10**.

In addition, the control unit **2** is provided, in a second housing **20** having a square box shape, with a controller (not shown) to control the high voltage generator (not shown) and the fan **13**, and the second housing **20** is provided, on its surface, with indicators **21** and the like described later. The controller controlling an electric circuit forming the high voltage generator and the fan **13** can be provided inside the first housing **10** in the fan unit **1**, or inside the second housing **20** in the control unit **2**.

The fan unit **1** (refer to FIG. **3**) provided with the discharge electrodes **12**, the fan **13**, and the like in the first housing **10** and the control unit **2** (FIGS. **4-6**) provided with the controller and the like in the second housing **20** are formed separately from each other, and as shown in FIGS. **1** and **2**, are assembled detachably by coupling the first housing **10** and the second housing **20** to each other.

As seen from FIGS. **1-3**, the fan unit **1** has a finger guard **11**a at the air outlet **11** for air flow, which opens on a front **10***a* side of the first housing **10**, and an air inlet **14** provided on a back **10***b* side of the first housing **10** also has a finger guard **14***a* similarly, and in addition, finger grooves **15***a* formed in a cartridge **15** holding the discharge electrodes **12** are exposed in the upper portion of the front of the first housing **10**. The finger grooves **15***a* accommodate a user's fingers when attaching and detaching the cartridge **15** to and from the first housing **10**.

Further, a concave portion **16***a* is formed on a coupling face **16**, which is the bottom surface of the first housing **10**, and a first separate connector **17** is provided, which is a male connector, inside the concave portion **16***a*. The first separate connector **17** is located at the center of the coupling face **16** lengthwise and widthwise and extends lengthwise of the first housing **10**. The first separate connector **17** has a plurality of connection terminals **17***a* installed on both faces of a substrate, and the connection terminals **17***a* are connected to the discharge electrodes **12**, the fan **13**, the high voltage generator, or the like via a circuit for transmitting and receiving signals, not shown in the drawings. On coupling the fan unit **1** and the control unit **2**, the first separate connector **17** is inserted in a second separate connector **37** (refer to FIG. **4**), which is a female connector, provided on a coupling face **36** of the second housing **20**, and thereby is electrically connected to the second separate connector **37** to transmit and receive power and signals between both units **1** and **2**.

Meanwhile, as seen from FIGS. **1**, **4**, and **5**, the control unit **2** is provided, on a front **20***a* side of the second housing **20**, with the indicators **21** indicating various operating states of the ionizer, such as power indication, discharge indication, defect indication of the fan **13**, contamination indication of the discharge electrodes **12**, indication of balance of positive and negative ions, and various defect indications, and an adjuster for adjusting the operating states of the ionizer, such as airflow rate of the fan **13**. Although a rotary switch **22** for adjusting airflow rate, a power switch **23**, and the like are provided as such an adjuster in the Example shown in the drawings, other various adjusters can be provided. In addition, on the front **20***a* side of the second housing **20**, a control connector **24** for wiring is provided in order to be connected to an external power source for driving the high voltage generator and the fan **13** and also to transmit and receive various electric signals to and from the outside.

Further, a modular connector **25** for connecting to an external sensor, an FG terminal **26**, a DC jack **27** for connecting to an AC adaptor, and the like are provided on the front **20***a* side of the second housing **20**.

It should be noted that the front **20***a* side of the second housing **20** means not only the original meaning of the front of the second housing **20**, but should be taken as even including an area that is in the vicinity of the front, where it is possible to operate the adjusters and the like from the front side or be easily visible from the front side, and has substantially no difference from the front.

The second housing **20** of the control unit **2** forms, as shown in FIGS. **1** and **2**, a base to mount the fan unit **1**. For this reason, the width from front to back of the second housing **20** is larger than the width of the first housing **10** and a coupling face **36** is formed on the upper surface of the second housing **20**, and the fain unit **1** is mounted on the control unit **2** while the coupling face **36** abuts on the coupling face **16**, which is the bottom surface of the first housing **10**.

The width of the second housing **20**, however, may also be the same as or smaller than the width of the first housing **10**. In addition, although in the example shown in the drawings the length from left to right of the first housing **10** and the length of the second housing **20** are equal, the length of the first housing **10** may also be larger or smaller than the length of the second housing **20**.

The first housing **10** and the second housing **20** are configured to be coupleable in either condition of normal coupling, where the fan unit **1** and the control unit **2** are oriented in the same direction from front to back, or opposite coupling, where both units **1** and **2** are oriented in opposite directions from front to back. The normal coupling condition is, as shown in FIGS. **1** and **2**, a coupling condition where the front **10***a* of the first housing **10** and the front **20***a* of the second housing **20** are oriented in the same direction, and the opposite coupling condition is a coupling condition where the front **10***a* of the first housing **10** and the front **20***a* of the second housing **20** are oriented in opposite directions to each other, in other words, a coupling condition where the front **10***a* of the first housing **10** and a back **20***b* of the second housing **20** are oriented in the same direction.

Therefore, the first separate connector **17** provided in the first housing **10** and the second separate connector **37** provided in the second housing **20** are also connectable to each other in both cases where the fan unit **1** and the control unit **2** are in the normal coupling condition or in the opposite coupling condition, and the power/signal arrangement of the connection terminals **17***a* and **37***a* of both separate connectors **17** and **37** is configured such that the same power and signals are transmitted and received between the separate connectors **17** and **37** in either coupling condition.

The second separate connector **37** is, as shown in FIG. **4**, provided at a central position lengthwise and widthwise in the coupling face **36** inside a convex portion **36***a* formed on the coupling face **36** of the second housing **20**, and has a connection port **37***b*, and into which, the first separate connector **17** is to be inserted from above, the connection port **37***b* elongat-

edly extending lengthwise in the second housing **20**. In addition, the convex portion **36***a* elongatedly extends lengthwise of the second housing **20**, and when the fan unit **1** and the control unit **2** are coupled, is inserted into the concave portion **16***a* of the first housing **10** to be positioned by being fitted in between ribs **16***b* provided in inner walls of the concave portion **16***a*.

FIGS. **7**A and **7**B show an example of the power/signal arrangement in the connection terminals **17***a*, **37***a* of the separate connectors **17**, **37**.

The first separate connector **17** shown in FIG. **7**A has ten pairs of connection terminals **17***a* in total, counting two connection terminals **17***a* facing each other on each face of a substrate **17***b* as one pair, and the connection terminals **17***a* are connected to predetermined components or parts as, sequentially from the left side of the figure, terminals for power P**1** and P**2**, terminals for signals S**1** and S**2**, and terminals for grounding G and G, and the remaining four pairs of the connection terminals **17***a* are left unconnected. The two terminals for grounding G and G both can be used in the same way. The connection terminals **17***a* of the first separate connector **17** are arranged, therefore, with directionality in terms of connection. It should be noted that each pair of connection terminals **17***a* facing each other are electrically connected to each other.

In contrast, the second separate connector **37** shown in FIG. **7**B has ten pairs of connection terminals **37***a* in total, counting two connection terminals **37***a* facing each other across the connection port **37***b* as one pair, and the connection terminals **37***a* are connected to predetermined components or parts as, sequentially from the left side of the figure, terminals for power P**1** and P**2**, terminals for signals S**1** and S**2**, terminals for grounding G and G, terminals for signals S**2** and S**1**, and terminals for power P**2** and P**1**. The connection terminals **37***a* of the second separate connector **37**, therefore, have a bilaterally symmetrical power/signal arrangement, and the same power and signals are transmitted and received between both separate connectors **17** and **37** whether the first separate connector **17** is connected in the direction shown in FIG. **7**A or connected in the opposite direction lengthwise. It should be noted that each pair of the connection terminals **37***a* facing each other are electrically connected to each other.

However, the power/signal arrangement of the connection terminals **17***a* of the first separate connector **17** may also be bilaterally symmetrical and directionality may be given to the power/signal arrangement of the connection terminals **37***a* of the second separate connector **37**. Alternately, the power/signal arrangements of the connection terminals **17***a* and **37***a* of both separate connectors **17** and **37** can also be bilaterally symmetrical.

In order to fix the first housing **10** and the second housing **20** in a coupling condition, a bolt inserted through hole **18** extending lengthwise of the first housing **10** and reaching the concave portion **16***a* is opened near the lower edge adjacent to the coupling face **16** on end faces of both sides of the first housing **10**, and meanwhile, a screw hole **38** is provided at a position corresponding to the bolt inserted through hole **18** on end faces of both sides of the convex portion **36***a* formed on the coupling face **36** of the second housing **20**, and by screwing the bolt **19**) inserted through the bolt inserted through hole **18** into the screw hole **38**, the first housing **10** and the second housing **20** are mutually fixed.

Even in a case that the first housing **10** is mounted on the second housing **20** in the condition of being directed opposite from front to back to the case shown in the drawings (opposite coupling condition), the bolt inserted through hole **18** and the screw hole **38** can fix both housings **10** and **20** mutually with the bolt **19**.

In this case, even when the control unit **2** is coupled to the fan unit in either normal or opposite direction, both units remain in the unchanged orientation lengthwise and widthwise.

However, fixation of the first housing **10** and the second housing **20** may also be carried out from the front side or the back side by providing two such bolt inserted through holes **18** in alignment in the lower edge of the front or back of the first housing **10** and also providing two such screw holes **38** in alignment respectively for the front and the back of the convex portion **36***a*.

In addition, as seen from FIG. **2**, DIP switches **29***a* for setting functions and an adjuster **29***b* for finely adjusting ion balance are provided in a concave portion **28**, on which a lid can be put, on the back **20***b* side of the second housing **20**. It should be noted that the lid to be put on the concave portion **28** is omitted in the figure.

Further, on the back **20***b* side of the second housing **20**, as seen from FIGS. **2** and **6**, installation members **31**, **32** are laid to install the second housing **20** of the control unit **2** on a DIN rail **30** fixed on a wall or the like. One of the installation members **31** is fixedly provided with the second housing **20** and has hooks **31***a* on the edge to engage the hooks **31***a* on one of rail edges **30***a* of the DIN rail **30**. In addition, the other of the installation members **32** is provided with a movable engagement member **32***a* engaging on the other of the rail edges **30***b* of the DIN rail **30** and is configured to elastically engage the movable engagement member **32***a* with the rail edge **30***b*.

Although the second housing **20** of the control unit **2** generally forms a base for the fan unit **1** and is configured to be used such that the fan unit **1** is mounted on the control unit **2** put on an installation platform, the control unit **2** can also be fixed on a wall or the like, from where the indicators **21** are easily visible, using the DIN rail **30** as described above. In this case, the fan unit **1** is supported by an appropriate bracket and disposed at a separate position from the control unit **2**, and the separate connectors **17**, **37** provided on each coupling face **16**, **36** of the fan unit **1** and the control unit **2** are connected to each other with a separately provided separate cable, omitted in the drawings, thereby to be configured such that the power/signal is transmitted and received between corresponding terminals.

In addition, as shown in FIGS. **2** and **5**, a link connector **40** is provided on the bottom surface of the second housing **20** of the control unit **2**. The link connector **40** has the same structure as that of the control connector **24** and is parallel connected with the connector **24**, and in such cases as a plurality of ionizers are used in parallel, and as a plurality of control units **2** are collectively installed on the DIN rail **30** described above to connect the control units **2** and the fan units **1** with the separate cable for use, it can be used for transmitting and receiving the power/signal to and from the terminals at corresponding positions by connecting a control connector **24** on one side of a next ionizer and a link connector **40** on the other side respectively with the separate cable to construct crossover wiring as a whole. Carrying out such a crossover wiring enables to turn on all ionizers by turning on one of the ionizers. Although the link connector **40** is provided with a cover for covering it when not used, it is omitted in the drawings.

The invention claimed is:

1. An ionizer comprising: a fan unit provided, in a first housing, with a discharge electrode generating ions by application of a high voltage and a fan generating air flow to convey the ions generated at the discharge electrode; and a control

unit provided, in a second housing, with an indicator indicating an operating state of the ionizer and an adjuster for adjusting an operating state of the ionizer,

wherein the fan unit and the control unit are formed separately from each other, the units being coupled detachably while coupling faces of the first housing and the second housing abut on each other and are also changeable between a normal coupling condition, where both units are oriented in the same direction from front to back, and an opposite coupling condition, where both units are oriented in opposite directions from front to back, and

first and second separate connectors electrically connected to each other when the fan unit and the control unit are coupled are provided on the coupling faces, the separate connectors being mutually connectable in either case of the fan unit and the control unit being in the normal coupling condition or the opposite coupling condition and also having connection terminals with a power/signal arrangement configured such that power supply and signal transmission/reception between both separate connectors is achieved in either coupling condition of both units.

2. The ionizer according to claim **1**, wherein the power/signal arrangement of the connection terminals of at least one of the first and second separate connectors is bilaterally symmetrical.

3. The ionizer according to claim **1**, wherein a concave portion is formed on the coupling face of the first housing, the male type first separate connector is provided inside the concave portion, a convex portion is formed on the coupling face of the second housing, the female type second separate connector is provided inside the convex portion, and when abutting the coupling faces of the first housing and the second housing on each other, the convex portion fits in the concave portion and the first separate connector is inserted in the second separate connector to establish electrical connection.

4. The ionizer according to claim **2**, wherein a concave portion is formed on the coupling face of the first housing, the male type first separate connector is provided inside the concave portion, a convex portion is formed on the coupling face of the second housing, the female type second separate connector is provided inside the convex portion, and when abutting the coupling faces of the first housing and the second housing on each other, the convex portion fits in the concave portion and the first separate connector is inserted in the second separate connector to establish electrical connection.

5. The ionizer according to claim **1**, wherein the first separate connector and the second separate connector are provided at a center of a horizontal direction and a front-back direction of respective coupling faces of the first housing and the second housing.

6. The ionizer according to claim **2**, wherein the first separate connector and the second separate connector are provided at a center of a horizontal direction and a front-back direction of respective coupling faces of the first housing and the second housing.

7. The ionizer according to claim **3**, wherein the first separate connector and the second separate connector are provided at a center of a horizontal direction and a front-back direction of respective coupling faces of the first housing and the second housing.

8. The ionizer according to claim **1**, wherein the control unit also serves as a base to mount the fan unit, and the coupling faces are formed on a bottom surface of the first housing and an upper surface of the second housing and coupled to the control unit with the fan unit being mounted on the control unit.

9. The ionizer according to claim **3**, wherein the control unit also serves as a base to mount the fain unit, and the coupling faces are formed on a bottom surface of the first housing and an upper surface of the second housing and coupled to the control unit with the fan unit being mounted on the control unit.

10. The ionizer according to claim **5**, wherein the control unit also serves as a base to mount the fan unit, and the coupling faces are formed on a bottom surface of the first housing and an upper surface of the second housing and coupled to the control unit with the fan unit being mounted on the control unit.

11. The ionizer according to claim **1**, wherein a control connector to connect wiring from an external power source and wiring from another device transmitting and receiving various electric signals is provided on a front side of the second housing of the control unit.

12. The ionizer according to claim **3**, wherein a control connector to connect wiring from an external power source and wiring from another device transmitting and receiving various electric signals is provided on a front side of the second housing of the control unit.

* * * * *